FAQ – GTAW

1. What is TIG welding?

TIG welding, also known as Gas Tungsten Arc Welding (GTAW), is a welding process in that arc is created between non-consumable tungsten electrode & base metal. The weld area is protected from contamination by an inert gas, typically argon or helium, which is supplied through a welding torch.

2. What are the main advantages of TIG welding?

- Precision: Provides high control over the welding process, ideal for thin materials and intricate welds.
- Clean Welds: Produces clean, high-quality welds with minimal spatter and no flux.
- Versatility: Can be used to weld a wide range of metals including steel, stainless steel, aluminium, and more.
- No Slag: The process does not produce slag, reducing post-weld cleanup.

3. What materials can be welded with TIG?

TIG welding is suitable for welding a variety of metals, including:

- Carbon steel
- Stainless steel
- Aluminium
- Magnesium
- Copper and its alloys
- Titanium

4. What types of tungsten electrodes are used in TIG welding?

- Pure Tungsten (W): Generally used for welding in direct current (DC) mode.
- Thoriated Tungsten (WT20): Contains thorium oxide, offering better performance and longer life.
- Ceriated Tungsten (WC20): Contains cerium oxide, which is good for low amperage welding and provides a stable arc.
- Lanthanated Tungsten (WL20): Contains lanthanum oxide, suitable for both AC and DC welding and provides a stable arc.

5. What gases are used in TIG welding?

- Argon: Most commonly used as it provides excellent shielding and is suitable for most metals.
- Helium: Suitable for welding high thermal conductive materials like copper, thicker sections or high-speed applications. Increases the arc voltage automatically.

- Argon-Helium Mix: Provides a balance of the benefits of both gases, enhancing performance in specific applications.

6. What is the difference between AC and DC in TIG welding?

- DC (Direct Current): Typically used for welding ferrous metals and provides a steady arc. The electrode remains positive, and the weld pool is negative.
- AC (Alternating Current): Used mainly for welding aluminum and magnesium. AC helps to clean the oxide layer from the surface of these metals and provides better arc stability.

7. What are the typical settings for TIG welding?

- Voltage and Amperage: These settings vary depending on the material thickness and type of tungsten electrode & size used. For thin materials, lower amperage is used, while thicker materials require higher amperage.
- Gas Flow Rate: Typically set between 10-20 cubic feet per hour (cfh) depending on the application and size of the welding torch.

8. What safety precautions should be taken during TIG welding?

- Protective Gear: Wear a welding helmet with appropriate shade, gloves, and protective clothing.
- Ventilation: Ensure proper ventilation to avoid exposure to harmful fumes and gases.
- Fire Safety: Keep flammable materials away from the welding area and be prepared with a fire extinguisher.
- Electrical Safety: Follow all electrical safety guidelines to avoid electric shock.

9. How do you maintain a TIG welding torch?

- Clean the Nozzle: Regularly clean or replace the nozzle to ensure proper gas coverage and prevent contamination.
- Inspect the Tungsten Electrode: Check for wear or contamination and replace or clean it as necessary.
- Check Connections: Ensure that all connections are secure and free of damage.

10. What are common problems encountered in TIG welding?

- Porosity: Caused by contamination or improper shielding gas coverage.
- Weld Cracking: Can occur due to improper settings, poor material preparation, or thermal stresses.
- Inconsistent Arc: May be caused by a contaminated tungsten electrode or incorrect settings.
- Tungsten Inclusion: Use low current & don’t scratch the baseplate with tungsten electrode

11. What are the common techniques for TIG welding?

- Stringer Bead: A straight weld without weaving. Often used for thin materials or when a precise, straight weld is needed.
- Weaving: Moving the torch in a side-to-side motion to create a wider bead. Useful for thicker materials to ensure good fusion and coverage.
- Circular Motion: Used to create a consistent, circular weld pool and ensure even bead placement.

12. What is the role of the filler rod in TIG welding?

- Filler Rod: Provides additional material to fill the weld joint. It's added manually and is melted by the arc to fuse with the base material.
- Selection: Choose a filler rod that matches the base material in chemical composition, mechanical & Corrosion properties to ensure strong welds.

13. How do you handle tungsten contamination?

- Prevention: Avoid touching the tungsten electrode with your bare hands and keep it clean.
- Cleaning: Use a tungsten grinder or a dedicated sharpener to clean and sharpen the tungsten. Avoid using a file or sandpaper, which can introduce contaminants.

14. How do you set up a TIG welding machine polarity for different materials?

- Steel: Set the machine for DCEN (Direct Current Electrode Negative) and select appropriate amperage and voltage based on material thickness.
- Aluminium: Use AC (Alternating Current) with a balance setting that cleans the oxide layer while providing adequate heat. Adjust the amperage according to thickness.
- Stainless Steel: Use DCEN with appropriate amperage and voltage settings, like steel, but consider using specific filler rods for stainless steel.

17. Can TIG welding be automated?

- Yes: TIG welding can be automated using robotic arms and automated welding systems, especially for repetitive tasks or high-precision applications.
- Considerations: Automation requires careful setup, programming, and regular maintenance to ensure consistent quality.

18. How does TIG welding compare to MIG welding?

- Precision: TIG welding offers more control and precision, making it suitable for thin materials and detailed work. MIG welding is typically faster and better for thicker materials.
- Cleanliness: TIG welding produces cleaner welds with minimal spatter, while MIG welding may require additional cleanup.
- Ease of Use: MIG welding is generally easier for beginners due to its continuous feeding of wire, whereas TIG requires more skill and manual control.

19. What are the best practices for TIG welding thin materials?

- Lower Heat: Use lower amperage settings to avoid burn-through or warping.
- Proper Technique: Maintain a steady hand and proper torch angle to ensure consistent heat and weld bead.
- Preheat: For very thin materials, preheating can help with better fusion and reduce the risk of distortion.

20. How do you ensure proper gas shielding in TIG welding?

- Gas Flow Rate: Set the flow rate to provide adequate shielding without causing turbulence. Typically, 10-20 cubic feet per hour (cfh) is a good range.
- Check for Leaks: Ensure there are no leaks in the gas delivery system that could compromise shielding.
- Torch Positioning: Keep the torch at the correct angle and distance to ensure effective gas coverage over the weld area.

21. What is the effect of tungsten electrode size on TIG welding?

- Electrode Diameter: The diameter of the tungsten electrode affects the size of the arc and the amount of current that can be handled. Larger electrodes can handle higher currents and provide a more stable arc, while smaller electrodes are better for lower currents and precision work.
- Application: For thin materials, a smaller diameter tungsten is typically used, while thicker materials require a larger diameter tungsten for effective heat distribution.

22. How do you control the heat input in TIG welding?

- Amperage Settings: Adjusting the amperage controls the amount of heat applied to the weld. Higher amperage increases heat input, while lower amperage reduces it.
- Travel Speed: Faster travel speeds reduce heat input, while slower speeds increase it, affecting the weld pool size and penetration.

23. What is the role of pulse welding in TIG welding?

- Pulse Welding: This technique involves modulating the welding current between a high peak and a low background level. It helps control heat input, improve bead appearance, and reduce distortion, especially on thin materials.
- Benefits: Pulse welding can enhance control overheat and weld profile, reduce heat input, and improve overall weld quality.

24. How does tungsten contamination affect TIG welding performance?

- Effects: Contaminated tungsten can lead to unstable arcs, poor weld quality, and increased spatter. Contamination usually occurs from contact with other materials or improper handling.
- Prevention and Fix: Regularly inspect and clean the tungsten electrode. Use a dedicated tungsten grinder to remove contamination and maintain the electrode's sharpness.

25. What is the significance of the tungsten electrode's tip shape?

- Tip Shapes: The shape of the tungsten tip affects the arc stability and weld bead formation. Common shapes include pointed, balled, and truncated.
- Pointed Tip: Provides a concentrated arc, ideal for precision welding.
- Balled Tip: Used for AC welding with aluminum, as it helps in stabilizing the arc and improves cleaning action.
- Truncated Tip: Provides a broader, more stable arc and is useful for higher amperage applications.

26. How do you address overheating or burn-through in TIG welding?

- Overheating: Occurs when excessive heat causes the base material to melt too quickly, leading to distortion or burn-through.
- Prevention: Adjust the amperage settings, increase travel speed, or use a back-up plate to manage heat input. Ensure proper torch positioning and maintain appropriate gas shielding.

27. Can TIG welding be used for welding dissimilar metals?

- Yes, TIG welding can be used to weld dissimilar metals, but it requires careful selection of filler materials and adjustments to the welding parameters to ensure compatibility and strong welds.

28. What are the differences between using a foot pedal versus a hand control for TIG welding?

- Foot Pedal: Allows for precise control of the welding current with your foot, enabling you to adjust heat input while focusing on the weld area. It's often preferred for applications requiring variable heat control.
- Hand Control: Mounted on the welding torch or nearby, it provides control over the current but may be less precise compared to a foot pedal. It's useful for applications where you need to adjust settings quickly and frequently.

29. How do you perform a TIG weld on a joint with a narrow gap?

- Technique: Use a smaller diameter tungsten electrode and fine-tune your welding parameters to manage heat and achieve penetration in the narrow gap.
- Filler Rod: Introduce the filler rod carefully to avoid disrupting the arc or causing defects. You may need to manipulate the rod to fill the gap evenly.

30. What is the effect of gas flow rate on TIG welding quality?

- Gas Flow Rate: A correct gas flow rate ensures proper shielding of the weld area, preventing contamination and oxidation. Too high a flow rate can cause turbulence and contamination, while too low a flow rate can result in inadequate shielding.
- Adjustment: Set the flow rate according to the torch size and type of workpiece, typically between 10-20 cubic feet per hour (cfh), to achieve optimal shielding and weld quality.

31. What is the purpose of tungsten sharpening and how should it be done?

- Purpose: Sharpening the tungsten electrode ensures a stable arc and precise weld control. A properly sharpened tungsten helps in achieving clean and consistent welds.
- Method: Use a tungsten grinder or a dedicated sharpener. Avoid using a file or sandpaper, which can introduce contaminants. Ensure the electrode is ground to a point for DC welding or a ball for AC welding.

32. How do you choose the right filler rod for TIG welding?

- Material Match: Select a filler rod that matches the base material in composition and properties to ensure compatibility and strong welds.
- Diameter: Choose the diameter of the filler rod based on the material thickness and welding position. Smaller rods are typically used for thinner materials and precise work.
- Alloy Specifications: Ensure the filler rod meets the required alloy specifications for the intended application, especially for high-strength or specialized materials.

33. What is the role of the gas nozzle in TIG welding?

- Purpose: The gas nozzle directs the shielding gas flow over the weld area, protecting the molten weld pool from contamination and oxidation.
- Types: Nozzles come in various sizes and shapes to accommodate different welding applications and torch types. Larger nozzles provide more coverage but may limit visibility, while smaller nozzles offer precision but less coverage.

34. How do you maintain and clean TIG welding consumables?

- Tungsten Electrodes: Regularly inspect for contamination or wear. Clean or sharpen the electrodes as needed using appropriate tools.
- Filler Rods: Store filler rods in a clean, dry place to prevent contamination. Inspect for damage or corrosion before use.
- Nozzles: Clean nozzles regularly to remove spatter and buildup that can obstruct gas flow. Replace damaged or worn nozzles as necessary.

35. How does High-Frequency High Voltage Start work in TIG welding?

- Function: High-frequency start uses an electrical signal to create an initial arc between the tungsten electrode and the workpiece. This high-frequency signal ionizes the air, allowing the arc to strike without direct contact.
- Benefits: Provides a clean and reliable arc start, reduces tungsten contamination, and extends the life of the tungsten electrode.

36. What is the role of AC Balance Control in TIG welding with aluminum?

- AC Balance Control: This feature adjusts the ratio of positive and negative polarity during the AC cycle. The positive polarity (electrode positive) cleans the oxide layer on aluminum, while the negative polarity (electrode negative) provides better penetration.

- Adjustments: Increasing the positive balance improves cleaning but can reduce penetration, while a higher negative balance improves penetration but may not clean as effectively.

37. How does the use of a Gas Lens affect TIG welding performance?

- Gas Lens: A gas lens is an accessory that improves the distribution of shielding gas, providing better coverage and reducing turbulence around the weld area.
- Advantages: Enhances weld quality by reducing the risk of contamination and improving arc stability. Useful for achieving a cleaner weld, especially in challenging positions or with small diameter nozzles.

38. What is the significance of a Water-Cooled TIG Torch in high-amperage applications?

- Water-Cooled Torch: Utilizes a water-cooling system to dissipate heat generated during high-amperage welding.
- Advantages: Allows for longer welding periods and higher heat input without overheating the torch, improving comfort and prolonging the life of the torch components.

39. How does TIG welding automation enhance productivity and consistency?

- Automation: Uses robotic arms or programmable systems to perform TIG welding tasks with precision and repeatability.
- Benefits: Increases productivity by allowing continuous operation, enhances consistency by reducing human error, and can be used in high-volume or complex applications.

40. What is the role of TIG welding in the additive manufacturing (3D printing) process?

- Additive Manufacturing: TIG welding can be used in additive manufacturing to build up layers of material to create complex parts or repair existing components.
- Advantages: Provides precise control over material deposition and can be used for both metallic and non-metallic materials in various 3D printing applications.

41.Why Always TIG weldmetal is high quality compared to any other arc welding process weld metal?

- In the TIG (Tungsten Inert Gas) welding process, flux is not used as it is in SMAW (Shielded Metal Arc Welding) and SAW (Submerged Arc Welding).
- Unlike MIG (Metal Inert Gas) welding, where gas shielding can be influenced by the process, TIG welding exclusively uses 100% inert gases.
- TIG welding exclusively uses 100% inert gases. This ensures that TIG weld metal remains highly pure and free from oxygen & Nitrogen inclusions.

42. TIG welding uses Constant Current or Constant Voltage Power source?

Constant Current type power sources used in TIG welding machine. Since TIG welding involves manual control of the arc length by the welder, a constant current power supply adjusts the voltage automatically to keep the current steady, which is critical for maintaining the quality of the weld.

43. What are the arc initiation method in TIG welding?

- Touch Start method.
- Lift arc method.
- High Frequency discharge start.
- Pilot arc method.

44. What are the parts of Tig Torch?

- Gas Nozzle
- Collet
- Collet body
- Gas Nozzle
- Tungsten electrode
- Gas lens
- Back cap

45. What are the parts of Tig welding machine?

- Welding power supply
- Welding torch
- Welding cables
- Gas shielding system

46. Which welding polarity will deliver better penetration in Tig welding?

- DC Electrode Negative (DCEN) or Direct Current Electrode Negative provides better penetration. In this polarity, the tungsten electrode is connected to the negative terminal of the power source, and the workpiece is connected to the positive terminal.
- DC Electrode Positive (DCEP) or Direct Current Electrode Positive results in less penetration compared to DCEN. In this polarity, the tungsten electrode is connected to the positive terminal, and the workpiece is connected to the negative terminal. It was suitable for oxide layer cleaning & cladding applications.

47. AWS / ASME SEC II C Specifications for Filler Metals Suitable for Gas Tungsten Arc Welding (TIG or GTAW)?

• SFA 5.2 Specification for Carbon and Low Alloy Steel Rods for Oxyfuel Gas Welding

• SFA 5.7 Specification for Copper and Copper Alloy Bare Welding Rods and Electrodes

• SFA 5.9 Specification for Bare Stainless-Steel Electrodes and Rods

• SFA 5.14 Specification for Nickel and Nickel Alloy Bare Welding Electrodes and Rods.

• SFA 5.16 Specification for Titanium and Titanium Alloy Electrodes and Welding Rods.

• SFA 5.18 Specification for Carbon Steel Filler Metals for Gas Shielded Arc Welding.

• SFA 5.19 Specification for Magnesium Alloy Welding Electrodes and Rods

• SFA 5.21 Specification for Composite Surfacing Welding Rods and Electrodes.

• SFA 5.24 Specification for Zirconium and Zirconium Alloy Welding Electrodes and Rods.

• SFA 5.28 Specification for Low-Alloy Steel Filler Metals for Gas Shielded Arc Welding.

48. What was the meaning SFA 5.18 ER70S-2 Filler wire?

ER – Electrode Rod

70 - Minimum UTS of 70 KSI

S - Solid Wire

2 - Chemical composition of wire as per ASME Sec II C SFA 5.18

49. Applications of TIG welding?

- High quality applications.
- Root pass welding in tubes and pipes.
- Aerospace and defence applications.
- Nuclear and Petrochemical applications.
- Welding of thin sheets.
- Tube to tube-sheet welding
- TIG spot welding
- TIG Dressing of weld profiles to improve fatigue life of component.

50. ISO Standards related to TIG Consumables?

- ISO 636:2017 Welding consumables — Rods, wires and deposits for tungsten inert gas welding of non-alloy and fine-grain steels — Classification
- ISO 16834:2012 Welding consumables — Wire electrodes, wires, rods and deposits for gas shielded arc welding of high strength steels — Classification
- ISO 21952:2012 Welding consumables — Wire electrodes, wires, rods and deposits for gas shielded arc welding of creep-resisting steels — Classification
- ISO 14343:2017 Welding consumables — Wire electrodes, strip electrodes, wires and rods for arc welding of stainless and heat resisting steels — Classification
- ISO 18274:2023 Welding consumables — Solid wire electrodes, solid strip electrodes, solid wires and solid rods for fusion welding of nickel and nickel alloys — Classification
- ISO 24373:2018 Welding consumables — Solid wires and rods for fusion welding of copper and copper alloys — Classification
- ISO 24034:2020 Welding consumables — Solid wire electrodes, solid wires and rods for fusion welding of titanium and titanium alloys — Classification

51. what are the commonly observed welding defects in TIG welding, list down causes & remedies of it?

1. Porosity

Small holes or voids in the weld metal caused by trapped gas bubbles.

- **Causes:**
    - Contaminated base material or filler metal.
    - Inadequate gas shielding.
    - Welding in windy conditions.

    - Poor joint fit-up.
- **Remedies:**
    - Ensure thorough cleaning of the base material before welding.
    - Maintain proper gas flow and ensure no draft or wind affects the welding area.
    - Use high-quality, uncontaminated filler materials.
    - Properly position the workpieces to prevent contamination.

2. Underfill

Insufficient weld metal in the weld joint, resulting in a recessed weld face.

- **Causes:**
    - Incorrect welding technique or travel speed.
    - Inadequate filler metal addition.
- **Remedies:**
    - Adjust welding technique to ensure adequate filler metal is applied.
    - Maintain proper travel speed and work angle.

3. Overlap

Excess weld metal that flows over the edge of the base material without properly fusing to it.

- **Causes:**
    - High welding speed or too much filler metal.
    - Incorrect torch angle.
- **Remedies:**
    - Adjust the welding speed and filler metal feed rate.
    - Maintain proper torch angle and position.

4. Cracking

Cracks that appear on or near the weld bead, which can be surface or internal.

- **Causes:**
    - Rapid cooling or excessive heat input.
    - High levels of hydrogen or other impurities in the weld.
    - Thermal stress or improper joint design.
- **Remedies:**
    - Control heat input and cooling rates.

- Use low-hydrogen filler materials and ensure proper shielding.
- Design joints to minimize stress concentrations.

5. Burn-Through

Holes or thin spots in the base material caused by excessive heat input.

- **Causes:**
  - Excessive welding current or voltage.
  - Welding too close to the material edge.
- **Remedies:**
  - Adjust the welding parameters to avoid excessive heat.
  - Ensure proper fit-up and joint preparation.

6. Undercut

A groove or recess along the edges of the weld bead, reducing the strength of the joint.

- **Causes:**
  - Excessive welding heat or incorrect torch angle.
  - High welding speed or insufficient filler metal.
- **Remedies:**
  - Adjust welding heat and speed.
  - Maintain proper torch angle and filler metal addition.

7. **Tungsten Inclusion?**

Presence of tungsten particles that are embedded within the weld metal. Tungsten is a hard, refractory metal used in TIG welding for the electrode, and when these particles become trapped in the weld, they can cause several problems.

- **Causes:**
  - Incorrect electrode stick out distance
  - Electrode Contamination
  - Improper welding technique
  - Excessive electrode wear
  - Inadequate gas shielding
  - High amperage usage

- **Remedies:**
  - Maintain correct electrode stick out distance

- Proper electrode preparation
- Optimize welding parameters
- Regularly inspect & replace the tungsten electrodes
- Ensure adequate gas shielding